

# General-Purpose CMOS Analog Switches

IH5040-IH5045/IH5047

## General Description

The IH5040 family consists of seven CMOS analog switches that are intended for general-purpose applications. These switches are latch-up proof, break-before-make single, dual, and quad versions of the popular switch formats SPST, SPDT, DPST, and 4PST. Key features of the family include a low, 1nA leakage current and a quiescent current of less than 1µA.

Maxim's IH5040 family has faster switching times than the original manufacturer's devices. All devices are bidirectional and maintain almost constant on resistance throughout their operating range. These switches are guaranteed to operate from ±4.5V to ±18V, and will switch input signals that include the supplies.

## Applications

- PBX, PABX
- Guidance and Control Systems
- Test Equipment
- Sample-and-Holds
- Military Radios

## Features

- ◆ Improved Second Source
- ◆ Guaranteed ±4.5V to ±18V Operation
- ◆ Input Voltage Range Includes Supplies
- ◆ Latchup-Proof Construction
- ◆ TTL/CMOS Logic Compatible
- ◆ >1µA Quiescent Current
- ◆ Monolithic, Low-Power CMOS Design

## Ordering Information

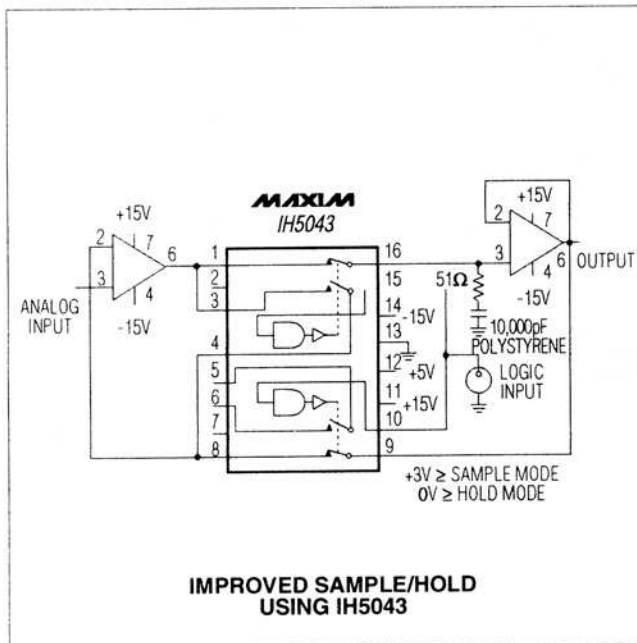
PART	TEMP. RANGE	PIN-PACKAGE
<b>SINGLE POLE, SINGLE THROW (SPST)</b>		
IH5040CPE	0°C to +70°C	16 Plastic DIP
IH5040CWE	0°C to +70°C	16 Wide SO
IH5040 CJE	0°C to +70°C	16 CERDIP
IH5040C/D	0°C to +70°C	Dice*
IH5040MJE	-55°C to +125°C	16 CERDIP**

Ordering Information continued at end of data sheet.

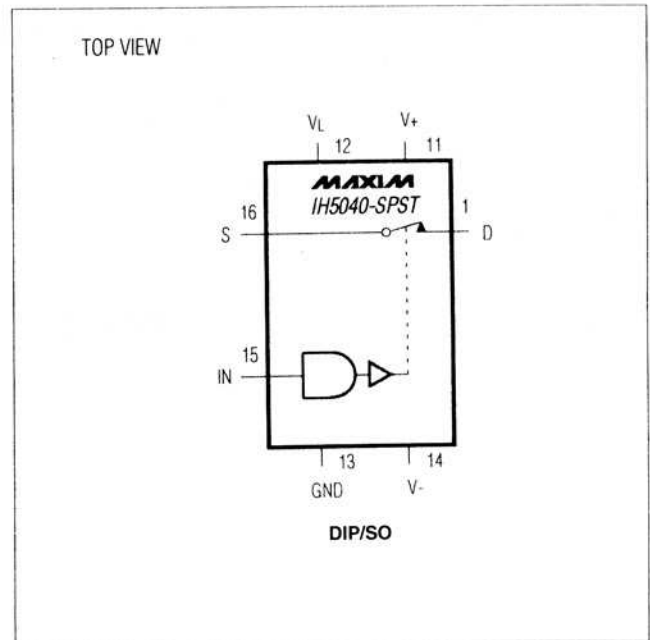
\* Contact factory for dice specifications.

\*\* Contact factory for availability and processing to MIL-STD-883.

## Typical Operating Circuit



## Pin Configurations & Switching-State Diagrams



# General-Purpose CMOS Analog Switches

## ABSOLUTE MAXIMUM RATINGS

V+ to V-	44V	Continuous Power Dissipation (TA = +70°C)	
V+ to VD	30V	Plastic DIP (derate 10.53mW/°C above +70°C)	842mW
VD to V-	30V	Wide SO (derate 9.52mW/°C above +70°C)	762mW
VD to VS	±22V	CERDIP (derate 10.00mW/°C above +70°C)	800mW
VL to V-	33V	TO-100 (derate 6.67mW/°C above +70°C)	533mW
VL to VIN	30V	Operating Temperature Ranges:	
VL to GND	20V	IH504_C_	0°C to +70°C
VIN to GND	20V	IH504_M_	-55°C to +125°C
Digital Inputs (V+ + 0.3V) to (V+ - 44V)		Storage Temperature Range	-65°C to +150°C
VS or VD (Note 1)	-0.3V to (V+ + 0.3V)	Lead Temperature (soldering, 10sec)	+300°C
Current (any terminal)	30mA		

**Note 1:** Signals on S, D, and digital inputs that exceed V- or V+ will be clamped by internal diodes. Limit forward diode current to 30mA maximum.

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## ELECTRICAL CHARACTERISTICS

(V+ = 15V, V- = -15V, VL = 5V, TA = +25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	IH504_M			IH504_C			UNITS	
			MIN	TYP	MAX	MIN	TYP	MAX		
Input Logic Current	IIN(ON)	VIN = 2.4V	TA = +25°C	-1		1	-1		1	µA
			TA = TMAX	-10		10	-10		10	
	IIN(OFF)	VIN = 0.8V	TA = +25°C	-1		1	-1		1	
			TA = TMAX	-10		10	-10		10	
Input Logic Low	VIL	TA = TMIN to TMAX			0.8			0.8	V	
Input Logic High	VIH	TA = TMIN to TMAX	2.4			2.4			V	
Drain-Source On Resistance	rDS(ON)	IS = 10mA, VANALOG = -10V to 10V	TA = +25°C			75			80	Ω
			TA = TMAX			150			130	
Channel-to-Channel rDS(ON) Match	ΔrDS(ON)			3			5		Ω	
Minimum Analog-Signal Handling Capability	VANALOG		-15		15	-15		15	V	
Switch-Off Leakage Current	ID/IS(OFF)	VANALOG = -10V to 10V	TA = +25°C	-1		1	-5		5	nA
			TA = TMAX	-100		100	-100		100	

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## ELECTRICAL CHARACTERISTICS (continued)

( $V_+ = 15V$ ,  $V_- = -15V$ ,  $V_L = 5V$ ,  $T_A = +25^\circ C$ , unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	IH504_M			IH504_C			UNITS	
			MIN	TYP	MAX	MIN	TYP	MAX		
Switch-On Leakage Current	$I_{D(ON)}$	$V_D = V_S = -10V$ to $10V$	$T_A = +25^\circ C$	-2		2	-10		10	nA
			$T_A = T_{MAX}$		-200		200		-100	
Switch-On Time	$t_{ON}$	Figure 1			400			400	ns	
Switch-Off Time	$t_{OFF}$	Figure 1			200			200	ns	
Charge Injection	$Q(INJ)$	Figure 2 (Note 2)		15			20		mV	
Minimum Off-Isolation Rejection Ratio	OIRR	Figure 3, $C_L < 5pF$		54			50		dB	
V+ Quiescent Current	$I_{+Q}$	$V_{IN} = 0V$ and $5V$	$T_A = +25^\circ C$			1			10	$\mu A$
			$T_A = T_{MAX}$			10			100	
V- Quiescent Current	$I_{-Q}$	$V_{IN} = 0V$ and $5V$	$T_A = +25^\circ C$	-1			-10			$\mu A$
			$T_A = T_{MAX}$	-10			-100			
$V_L$ Quiescent Current	$I_{LQ}$	$V_{IN} = 0V$ and $5V$	$T_A = +25^\circ C$			1			10	$\mu A$
			$T_A = T_{MAX}$			10			100	
Ground Quiescent Current	$I_{GND}$	$V_{IN} = 0V$ and $5V$	$T_A = +25^\circ C$	-1			-10			$\mu A$
			$T_A = T_{MAX}$	-10			-100			
Minimum Channel-to-Channel Cross-Coupling Rejection Ratio	CCRR	One channel off (Note 2)		54			50		dB	
Power-Supply Range for Continuous Operation	$V_{OP}$	(Notes 2, 3)		$\pm 4.5$		$\pm 18$	$\pm 4.5$		$\pm 18$	V

**Note 2:** Not production tested.

**Note 3:** Electrical characteristics, such as on resistance, will change when power supplies other than  $\pm 15V$  are used.

## Test Circuits

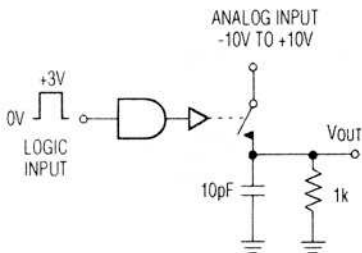


Figure 1. Switching Time

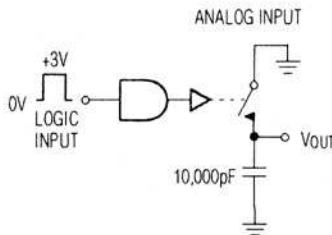


Figure 2. Charge Injection

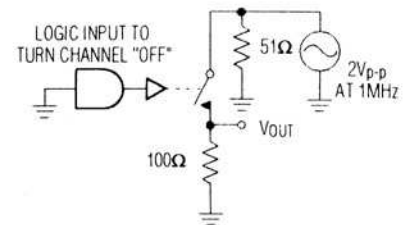
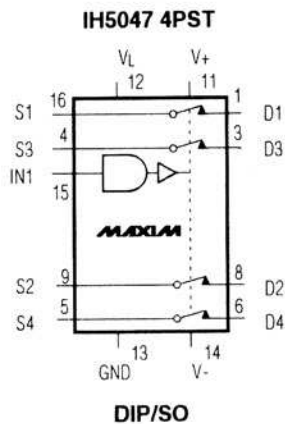
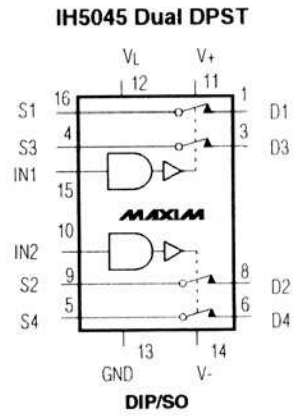
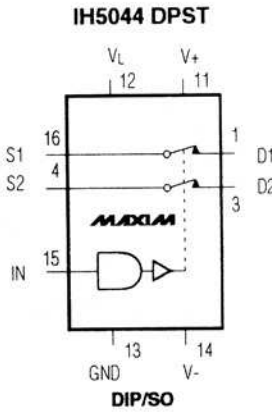
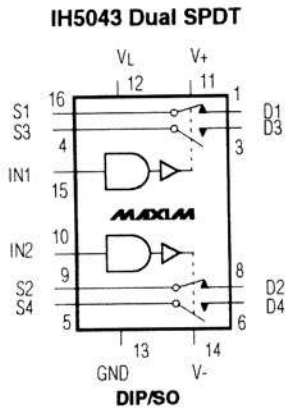
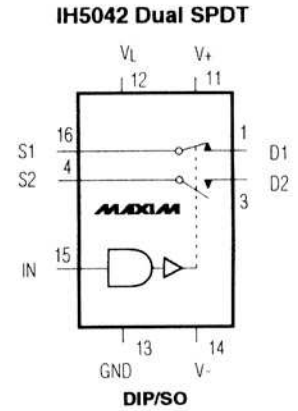
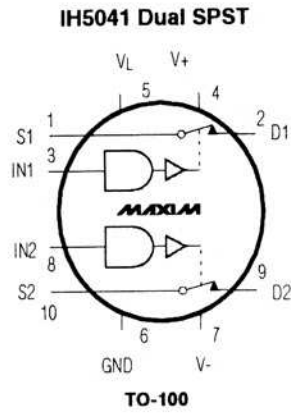
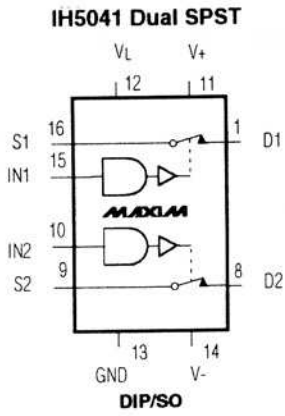


Figure 3. Off-Isolation Rejection Ratio

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## Pin Configurations & Switching-State Diagrams (continued)

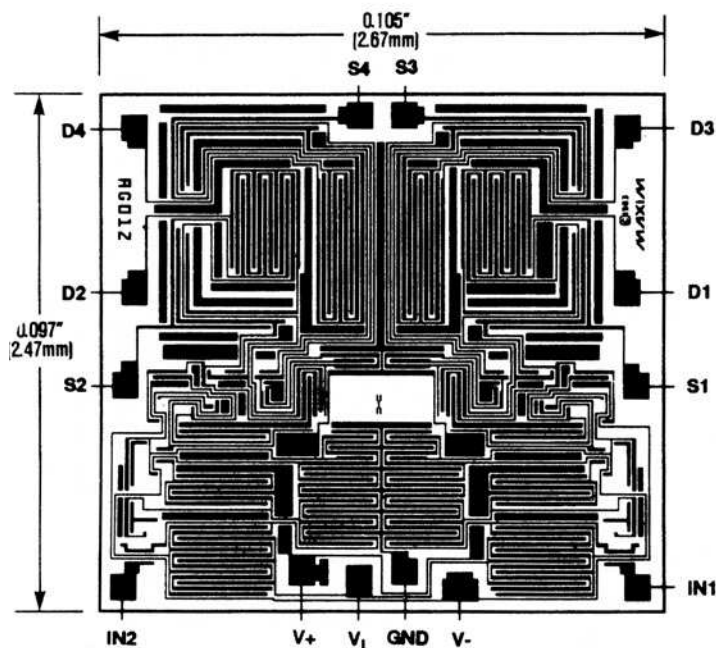


**Table 1. Using the IH5040 Family with Only Two Supplies**

SUPPLY VOLTAGES (V)	MINIMUM LOGIC I/P FOR "1" STATE (V)
±15	12.6
±12	9.6
±10	7.6
±5	2.6

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Chip Topography



Ordering Information (continued)

PART	TEMP. RANGE	PIN-PACKAGE
<b>DUAL, SINGLE POLE, SINGLE THROW (DUAL SPST)</b>		
IH5041CPE	0°C to +70°C	16 Plastic DIP
IH5041CWE	0°C to +70°C	16 Wide SO
IH5041CJE	0°C to +70°C	16 CERDIP
IH5041CTW	0°C to +70°C	16 TO-100†
IH5041C/D	0°C to +70°C	Dice*
IH5041MJE	-55°C to +125°C	16 CERDIP**
IH5041MTW	-55°C to +125°C	16 TO-100†
<b>SINGLE POLE, DOUBLE THROW (SPDT)</b>		
IH5042CPE	0°C to +70°C	16 Plastic DIP
IH5042CWE	0°C to +70°C	16 Wide SO
IH5042CJE	0°C to +70°C	16 CERDIP
IH5042C/D	0°C to +70°C	Dice*
IH5042MJE	-55°C to +125°C	16 CERDIP**
<b>DUAL, SINGLE POLE, DOUBLE THROW (DUAL SPDT)</b>		
IH5043CPE	0°C to +70°C	16 Plastic DIP
IH5043CWE	0°C to +70°C	16 Wide SO
IH5043CJE	0°C to +70°C	16 CERDIP
IH5043C/D	0°C to +70°C	Dice*
IH5043MJE	-55°C to +125°C	16 CERDIP**
<b>DOUBLE POLE, SINGLE THROW (DPST)</b>		
IH5044CPE	0°C to +70°C	16 Plastic DIP
IH5044CWE	0°C to +70°C	16 Wide SO
IH5044CJE	0°C to +70°C	16 CERDIP
IH5044C/D	0°C to +70°C	Dice*
IH5044MJE	-55°C to +125°C	16 CERDIP**
<b>DUAL, DOUBLE POLE, SINGLE THROW (DUAL DPST)</b>		
IH5045CPE	0°C to +70°C	16 Plastic DIP
IH5045CWE	0°C to +70°C	16 Wide SO
IH5045CJE	0°C to +70°C	16 CERDIP
IH5045C/D	0°C to +70°C	Dice*
IH5045MJE	-55°C to +125°C	16 CERDIP**
<b>QUAD POLE, SINGLE THROW (4PST)</b>		
IH5047CPE	0°C to +70°C	16 Plastic DIP
IH5047CWE	0°C to +70°C	16 Wide SO
IH5047CJE	0°C to +70°C	16 CERDIP
IH5047C/D	0°C to +70°C	Dice*
IH5047MJE	-55°C to +125°C	16 CERDIP**

\* Contact factory for dice specifications.

\*\* Contact factory for availability and processing to MIL-STD-883.

† Contact factory for availability.

IH5040-IH5045/IH5047

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## Package Information

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information go to [www.maxim-ic.com/packages](http://www.maxim-ic.com/packages).)

**Plastic DIP  
PLASTIC  
DUAL-IN-LINE  
PACKAGE  
(0.300 in.)**

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	—	0.200	—	5.08
A1	0.015	—	0.38	—
A2	0.125	0.175	3.18	4.45
A3	0.055	0.080	1.40	2.03
B	0.016	0.022	0.41	0.56
B1	0.045	0.065	1.14	1.65
C	0.008	0.012	0.20	0.30
D1	0.005	0.080	0.13	2.03
E	0.300	0.325	7.62	8.26
E1	0.240	0.310	6.10	7.87
e	0.100	—	2.54	—
eA	0.300	—	7.62	—
eB	—	0.400	—	10.16
L	0.115	0.150	2.92	3.81

PKG.	DIM	PINS	INCHES		MILLIMETERS	
			MIN	MAX	MIN	MAX
P	D	8	0.348	0.390	8.84	9.91
P	D	14	0.735	0.765	18.67	19.43
P	D	16	0.745	0.765	18.92	19.43
P	D	18	0.885	0.915	22.48	23.24
P	D	20	1.015	1.045	25.78	26.54
N	D	24	1.14	1.265	28.96	32.13

21-0043A

**Wide SO  
SMALL-OUTLINE  
PACKAGE  
(0.300 in.)**

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.093	0.104	2.35	2.65
A1	0.004	0.012	0.10	0.30
B	0.014	0.019	0.35	0.49
C	0.009	0.013	0.23	0.32
E	0.291	0.299	7.40	7.60
e	0.050		1.27	
H	0.394	0.419	10.00	10.65
L	0.016	0.050	0.40	1.27

DIM	PINS	INCHES		MILLIMETERS	
		MIN	MAX	MIN	MAX
D	16	0.398	0.413	10.10	10.50
D	18	0.447	0.463	11.35	11.75
D	20	0.496	0.512	12.60	13.00
D	24	0.598	0.614	15.20	15.60
D	28	0.697	0.713	17.70	18.10

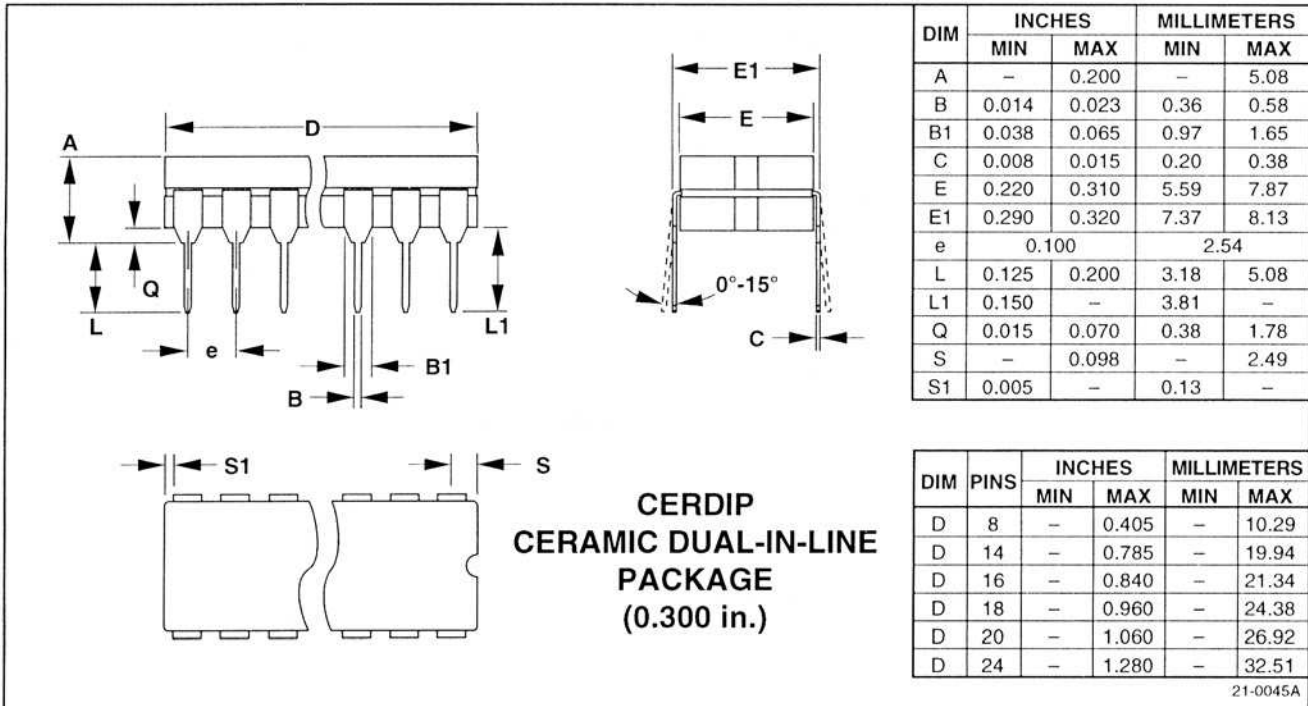
21-0042A

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## Package Information (continued)

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## **General-Purpose CMOS Analog Switches**

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